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Author(s): William H. reeves, Jonathan C. Knight , D. Skryabin D. Russel, University of Bath; Fiorenzo, Omenetto, Anatoly Efimov, Antoinette J. Taylor, MST-10

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Ultrafast optics in dispersion-flattened photonic crystal fiber

W.H. Reeves, J.C.Knight, D. Skryabin and P.St.J. Russell
Optoelectronics, School of Physics, University of Bath, Bath, BA2 7AY, UK

F.G. Omenetto, A. Efimov and A.J. Taylor
MST-10, MS K764, Los Alamos National Laboratory, Los Alamos, NM 87545

Abstract: 110fs pulses at 1550nm wavelength were launched in to various ultra flattened dispersion photonic crystal fibers. For output powers of around 100mW spectral components were generated in a range greater than 350-2200nm.

OCIS codes: (000.0000) General

1. Introduction

Photonic crystal fibers (PCFs) are optical fiber waveguides that are formed by an ordered array of air holes surrounding a core that can be hollow or solid [1]. In solid-core PCF, control of the diameter *d* and pitch Λ of the holes, coupled with the large contrast in the refractive index, offers greater control over waveguide dispersion than in conventional fibers.

We have fabricated a range of PCFs with different values of dispersion (+12ps/nm.km to -4ps/nm.km) but all with low dispersion slope at 1550nm [2,3] (Figure 1).

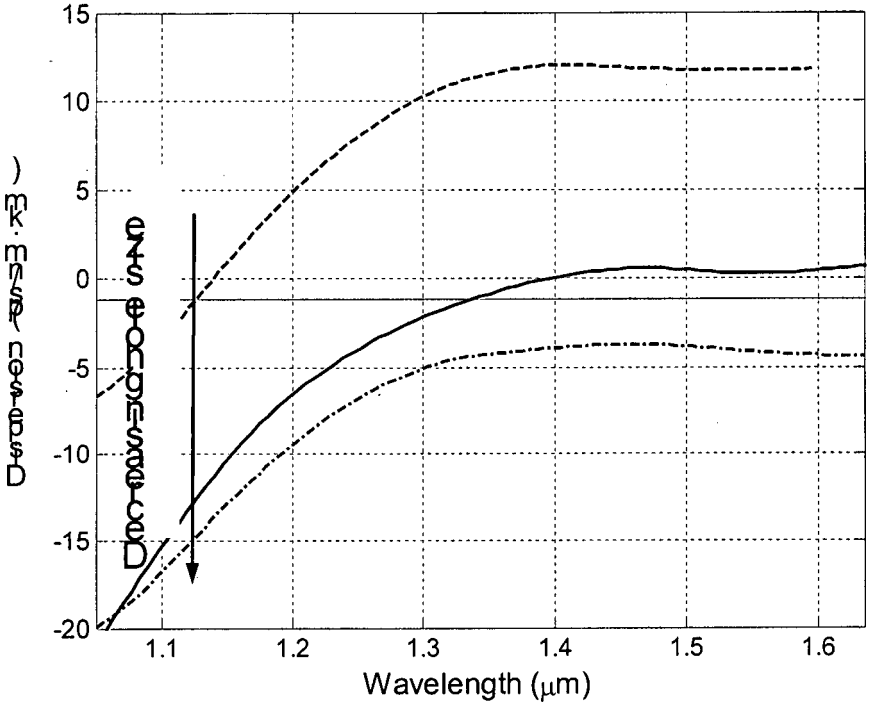

Fig. 1. Measured dispersion of fibers taken from a large set of UFD-PCF with constant pitch (Λ = 2.34μm) The dashed line corresponds to the fiber in power/spectral plot fig. 2. (b), the solid line (c) and the dot/dashed line (d). Fiber length under test was 235mm.

We present the results of ultrashort-pulse propagation in some of these fibers.

2. Experiment

1550nm, 110fs pulses at 80MHz (up to 240mW average power incident on fiber input face) from a Ti:Sapphire pumped OPO were launched into 1m lengths of ultra-flattened dispersion-PCF (UFD-PCF). The output spectra were recorded using a spectrometer for fiber output powers from 1mW up to the maximum power attainable, usually 100-150mW.

3. Results

Plots were generated showing intensity vs. output power and wavelength in order to get a feel of the nonlinear processes involved in the generation of supercontinuum. Figure 2 shows 4 of these plots, (a) shows the results for standard SMF28 fiber, (b) for a UFD-PCF with anomalous dispersion of 11ps/nm.km – dashed line in figure 1, (c) UFD-PCF with near zero dispersion of 0.5ps/nm.km – dotted line in figure 1 and (d) UDF-PCF fiber with normal dispersion of -5ps/nm.km – dash/dotted line in figure1.

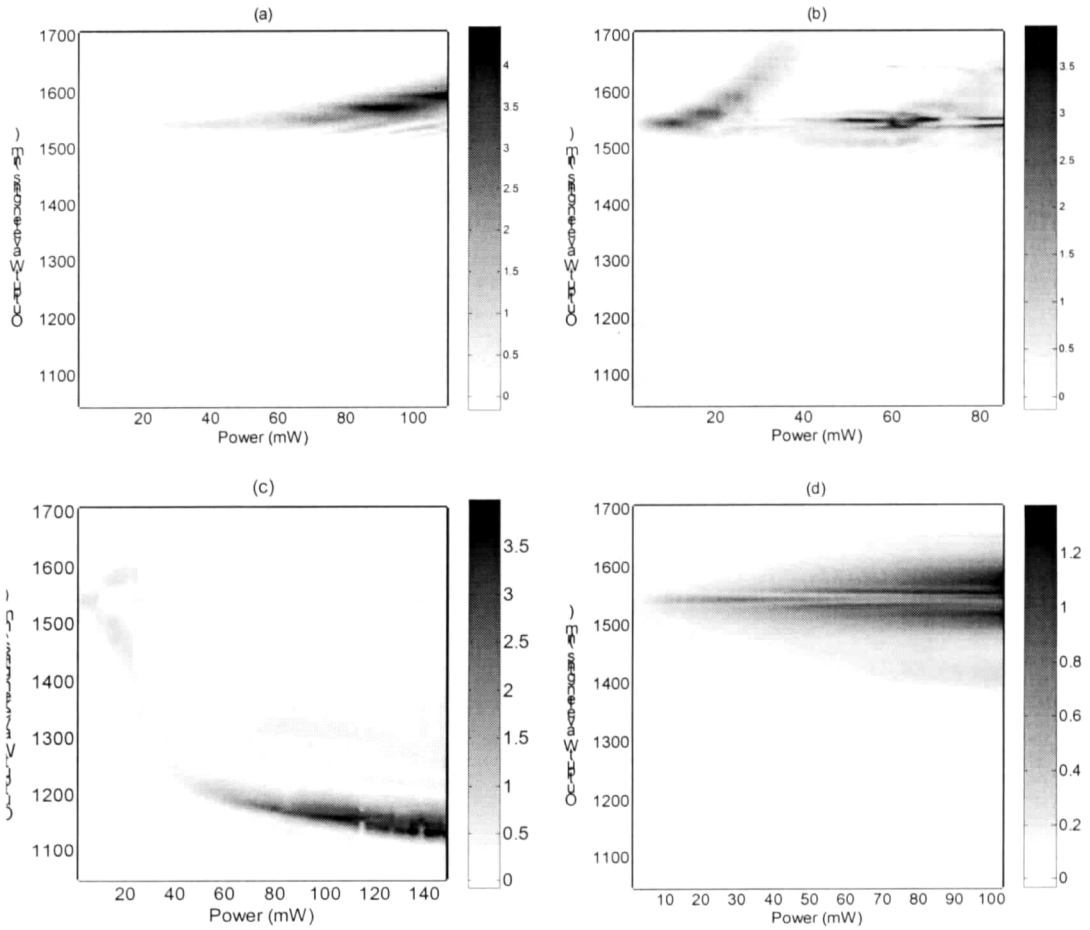

Fig. 2. Spectrum generated from (a) SMF28, (b) UFD-PCF with dispersion of approximately 11ps/nm.km, (c) UFD-PCF with 0.5ps/nm.km and (d) UFD-PCF with -4ps/nm.km. Power is measured from the output of the fiber.

In the talk, we will analyze the basic physical mechanisms responsible for the observed spectra.

We will also present data showing spectral features falling outside of the wavelength band covered in figure 2, on both the long and the short-wavelength side.

4. Conclusion

Nonlinear optics leading to supercontinuum generation has been observed by launching short pulses into UFD-PCF near the zero dispersion slope region (1550nm). This set of experiments gives insight into the mechanisms of supercontinuum generation and with further optimization of the fiber structure provide flattened spectral response, ultra broadband light sources in the IR.

References

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